# Burn severity and vegetation response in the Selway-Bitterroot Wilderness Area, 1900-2007

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## Introduction

***Introduction***: Wildfires have become more frequent in recent decades with an increase in size, duration, season length, and overall area burned per year since the mid 20th century, and area burned will likely increase in the future (Fig. 1 and Fig.2) [1, 2]. Although increases in wildfire extent and number of large fires are well documented for recent decades, we know little about multi-decadal trends in burn severity, patch size, and implications for species diversity [2,3].

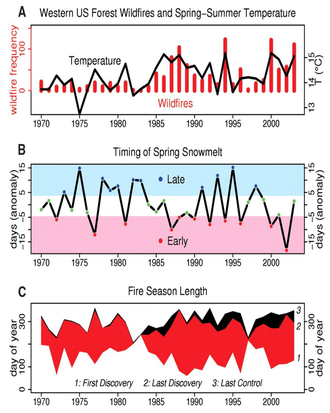



***Figure 1.*** Since the mid 1980's increases have been found in incidence of large wildfires and length of wildfire season in conjunction with early spring snowmelt. From Westerling et al. 2006

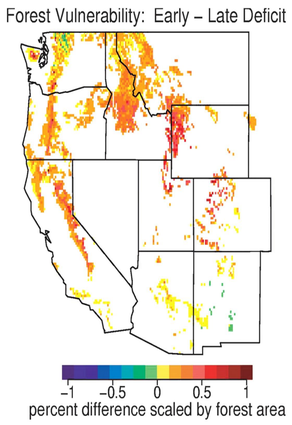



***Figure 2.*** Index of predicted forest vulnerability to increased occurrence of wildfires due to changes of spring snow melt timing. From Westerling et al. 2006

***Objectives***:

**1) Evaluate how the proportion of area burned severely has changed over time in the Selway-Bitterroot Wilderness Area (SBWA) for the years 1900-2007.**

**2) Evaluate how size distribution of high severity patches has changed over time (1900-2007) in the SBWA.**

**3) Assess the degree to which the distance to unburned edge affects post-fire vegetation response in high severity burn areas.**

Looking across to Magruder Ridge field sites, Magruder Corridor, Selway - Bitterroot Wilderness Area, 12 years post-burn. © Ashley Wells

***Background:*** We analyze the change in proportion of area burned severely across 542,747 ha in the Selway-Bitterroot Wilderness Area in Idaho and Montana, USA using 30-meter resolution fire perimeters and burn severities inferred from 1984-2007 satellite imagery from the Monitoring Trends in Burn Severity project and 1900-2000 aerial photography. Field data were collected 10m, 40m, and 80m from the unburned edge to evaluate edge effect for large high severity patches.

Looking east towards the mouth of Mill Creek in the Selway-Bitterroot Wilderness Area, near Hamilton, MT, 12 years post-burn. © Ashley Wells

## Justification

Vegetation response has been found to be greatly impacted by burn severity, but the effect of patch size has not been widely studied and longer-term studies are needed. Burn severity, which describes the degree of ecological change pre to post fire [4], has been shown to have increased in the Sierra Nevada Mountains [5], however a longer time series is needed to evaluate trends. Our research takes advantage of a unique data set with a long temporal series to examine multi-decadal trends across diverse topography and forest vegetation types to better understand the effects of high severity fires on the landscape.

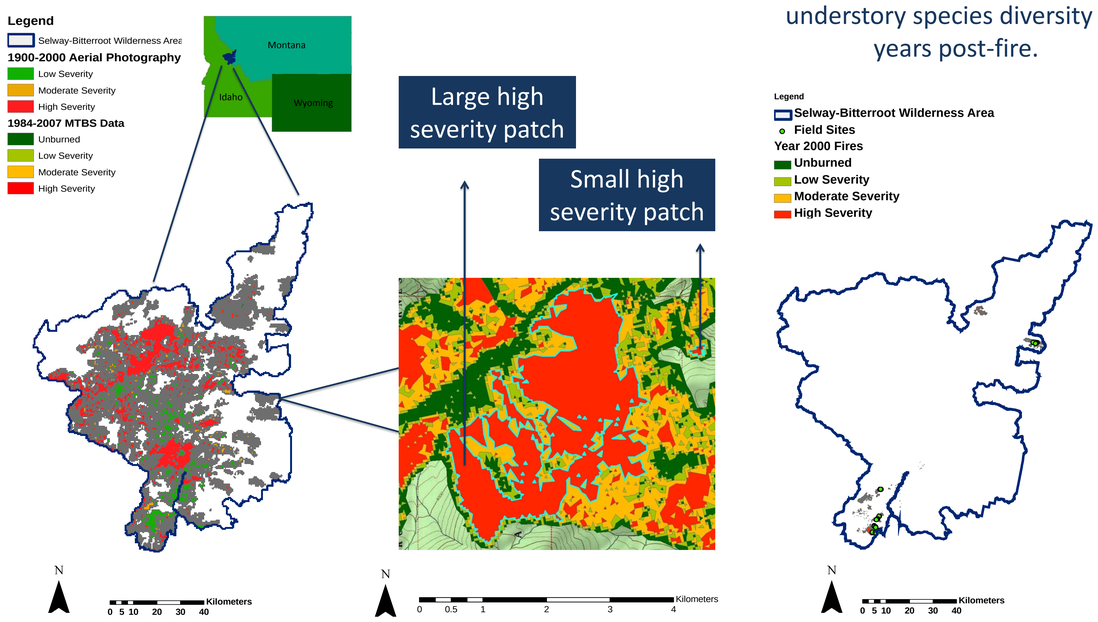
Observation Point, Selway-Bitterroot Wilderness Area, 12 years post-burn. © Ashley Wells

## Methods

Step 1: Quantify the proportion of area burned severely through time using the two data sets in ArcGIS.

Step 2: Analyze patch size distribution through time using the two data sets in ArcGIS.

Step 3: Sample 20 locations in the SBWA from the widespread fire year 2000 to assess post-fire tree seedling density and understory species diversity 12 years post-fire.




Note: Due to scale, patch delineation is less distinct and displays as gray.

## Results & Conclusions

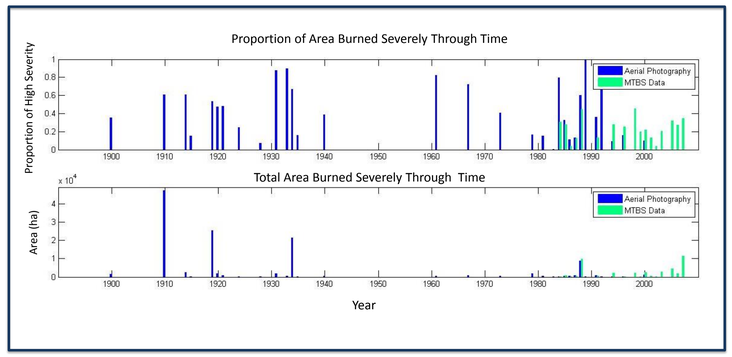



***Figure 3.*** Proportion and total area (ha) of high severity burned areas through time for the years 1900 – 2007 for 542,747 ha in the Selway -Bitterroot Wilderness Area. Burn severity inferred from satellite (MTBS) 1984 – 2007 and aerial photographs 1900 – 2000. High severity for MTBS is based on RdNBR values while the aerial photography data categorized high severity as >70% tree canopy mortality.

### *No Temporal Trend in Burn Severity*

Proportion of area burned severely varied considerably through time. The majority of the area burned across the record occurred in just a few years of widespread fire. Annual proportion burned severely differs for the two data sets due to the respective classifications and definitions of high severity.

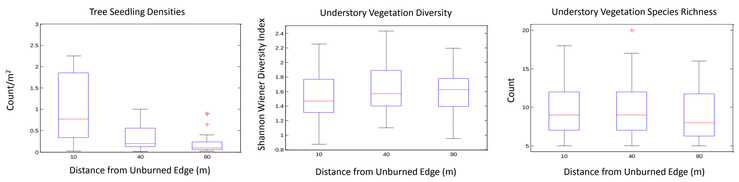



***Figure 4.*** **Left:** Densities of tree seedlings (aggregate of all species found) at varying distances from the unburned edge into a high severity burn patch. **Center:** Understory vegetation calculated using the Shannon Wiener Diversity Index. **Right:** Understory vegetation species richness (count) at distance from unburned edge. For all graphs N=20.

### *Tree Seedlings Densities Decrease as Distance from Edge Increases*

This is likely related to seed source. The unburned edge has less effect for understory vegetation diversity and species because many fire tolerant species resprout post-fire or establish from existing seed banks.

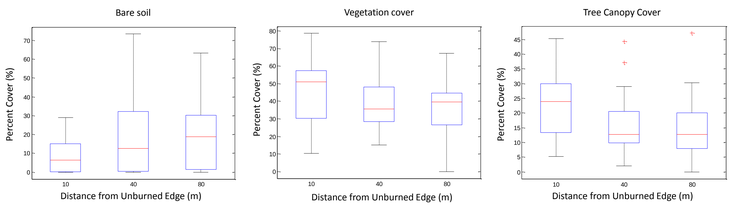



***Figure 5.*** Environment as a function of distance from unburned edge (m). **Left:** Percent cover of bare soil. **Center:** Percent cover of understory vegetation. **Right:** Percent cover of overstory tree canopy. For all graphs N=20.

### *The Edge Environment is Noticeably Different*

The edge environment differs from the middle of high severity burned patches. The edge is host to more understory vegetation, less bare soil, more shade, and provides an important seed source for establishing tree seedlings. The environment 80m into a high severity patch is one with more bare soil, less understory vegetation, and less canopy cover, which is dominated by burned snags as opposed to live trees. These variables help explain the tree seedling density and understory vegetation patterns.

## References

**[1]** Westerling, A. L., H. G. Hidalgo, et al. (2006). "Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity." Science **313**(5789): 940-943. **[2]** Morgan, P., E. K. Heyerdahl, and C. E. Gibson. 2008. Multi-season climate synchronized forest fires throughout the 20th century, northern Rockies, USA. Ecology **89**:717-728. **[3]** Keeley, J. E. (2009). "Fire intensity, fire severity and burn severity: a brief review and suggested usage." International Journal of Wildland Fire **18**(1). **[4]** Lentile, L. B., Z. A. Holden, et al. (2006). "Remote sensing techniques to assess active fire characteristics and post-fire effects." Int. J. Wildland Fire International Journal of Wildland Fire **15**(3). **[5]** Miller, J. D., H. D. Safford, et al. (2008). "Quantitative Evidence for Increasing Forest Fire Severity in the Sierra Nevada and Southern Cascade Mountains, California and Nevada, USA." Ecosystems **12**(1): 16-32.

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